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JOURNAL OF ELECTRICITY
POWER AND GAS
Devoted to the Conversion, Transmission and Distribution of Energy

VOLUME XXIII. SAN FRANCISCO, JULY 24, 1909 NUMBER 4

# GREAT NORTHERN THREE-PHASE ELECTRIFICATION

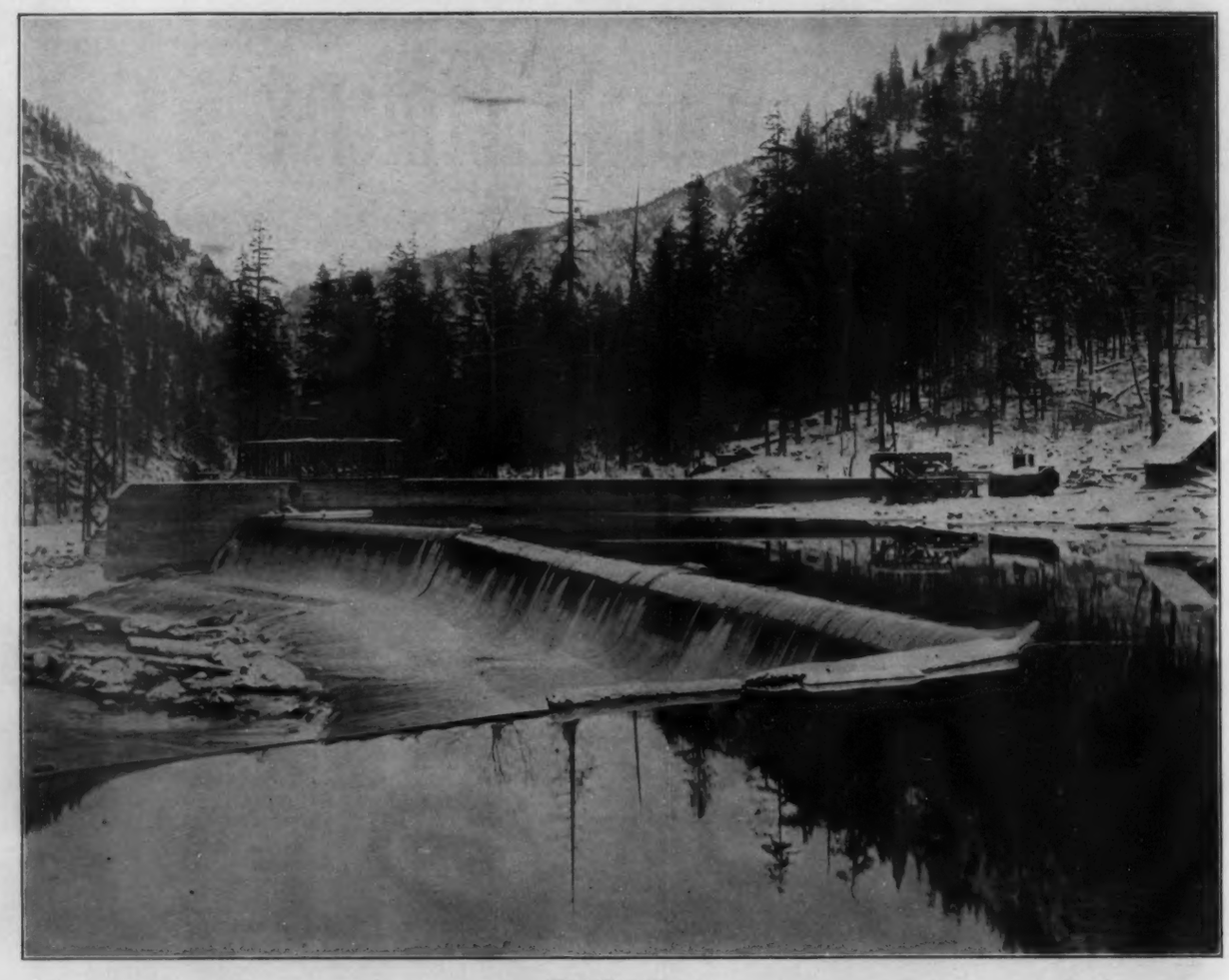
BY A. H. HALLORAN.

August, 1909, will witness regular service on the three-phase traction experiment by which the Great Northern railroad is to handle traffic through its Cascade tunnel in northern Washington. Because of its unique character and also by reason of novel methods for meeting enormous load fluctuations, this installation is of peculiar interest. It is the first three-phase railway electrification in America, and is designed to meet the difficult conditions entailed by sudden starting and stopping of the four electric locomotives, each equipped with four 500 horsepower motors, which are likely to be coupled to one train. The tunnel has an even grade of 1.7%, is 15,000 feet in length, and there may be times when all four of the locomotives will be required to haul some of the heavier freight trains. This installation is experimental and preliminary to the probable electrification of the entire mountain division. While it is as yet too soon to give full details of the construction and operation, a brief description of the installation is of interest. It consists essentially of a water-power plant furnishing current to operate three-phase electric locomotives.

**Fig. 1. Hydro-Electric Power Plant of the Great Northern Railway Three-Phase Electrification.**

### Generation.

The hydro-electric plant furnishing power for the electrification is in the Tumwater Canyon of the Wenatchee river, thirty miles below the tunnel and two miles above the town of Leavenworth, directly on the line of the Great Northern Railway. As shown in Fig. 1, it consists essentially of a substantial brick structure, housing the water-wheels, generators, exciters, and transformers. In the photograph is shown the stand-pipe taking up water-hammer in the pipe line and the steel bridge carrying the pipe line across the river.



**Diverting Dam.**

Water is diverted from the Wenatchee river about two miles above the power plant by means of a concrete dam with 400 foot crest and varying in height from 11 to 14 feet. Work was started on this dam in the fall of 1907 and by hard driving it was completed in May, 1908, just before the spring freshet.

**Fig. 2. Completed Pipe Line.**

Double gates of the usual rack and pinion type, hand operated for the present, control the water admission to the penstock.

This consists of 12,000 feet of 8½ foot pipe, giving a head of 180 feet to the wheels. Of this length, 11,000 feet is of wood stave pipe and the last 1000 feet of riveted steel. Fig. 2 shows the course of the pipe line down the river, and in Fig. 3 is shown the detail of its construction. The wood stave was furnished by the Pacific Coast Pipe Company of Tacoma. At the start ¾-in. steel bands were placed 10 in. apart to

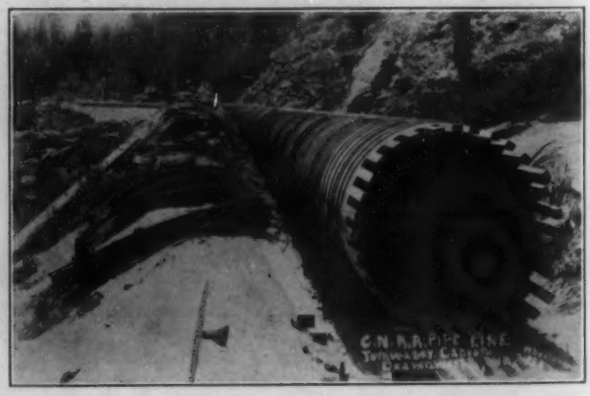


**Fig. 3. Wooden Stave Pipe Line During Construction.**

bind the staves together. These rods are increased in size to ⅞-in. in the middle and to 1-in. at the end, the spacing between them being correspondingly lessened to 2 in. Relief is provided by air-valves at the head and foot and by the stand pipe. The pipe is uncovered except in a few sections where there is danger from falling rock. At one point it was necessary to drive 600

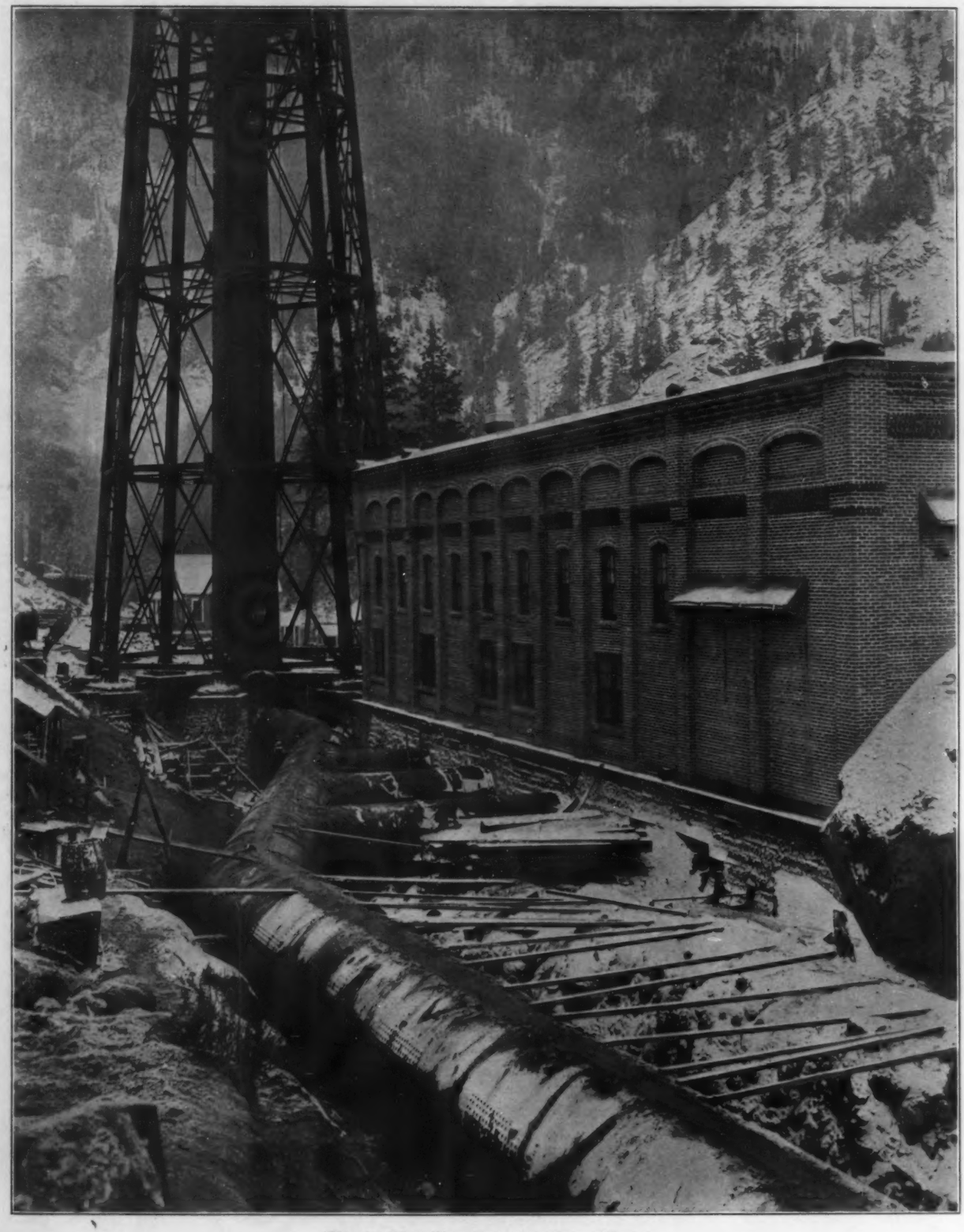


**Fig. 4. Pipe Line Entering Power House.**

feet through solid rock, so as to safely carry the line past a section where the river gorge narrows between steep walls. The run-off from intervening small streams along the line, is carried off by substantial concrete troughs which pass over the pipe. The joint between the wood and steel pipe was made by fitting the latter into the wood stave, double wedging and then packing with oakum.

As shown in Fig. 1, a riveted steel truss bridge, 200 feet long, carries the steel pipe across the river to the power-house. The difference in the expansion of the bridge and that of the pipe carrying ice cold water is taken up by a roller-bearing support under the bridge toe. The pipe is carried underneath the bridge by steel slings placed 12½ feet apart, giving a cradle support.

Water is supplied to the wheels by three branches from the main line at the power-house, one being temporarily plugged. To take up the shock or water-hammer due to sudden changes in velocity, resulting from load fluctuation a stand-pipe 180 feet high has been constructed at the end of the pipe line. This is surmounted by a 350,000 gallon tank, which is sufficient to supply both wheels for one minute, until the main column of water in the pipe has had time to assume full velocity. The stand pipe thus performs a dual function in acting as a relief valve, in case of excess pressure in the penstock, and in furnishing a supply of energy to take care of sudden increases in load while the water is accelerating, as well as in dissipating the excess energy in the moving water at the time of a sudden drop in the load. The stand-pipe consists of an 8-ft. riveted steel exterior section and a 3-in. interior overflow pipe incased in concrete.

This system supplies 400 second-feet of water to the two wheels, which are 42-inch Victor-Francis turbines with horizontal shaft and provided with Sturgess hydraulic governors and relief valves. The wicket gates are also fitted for hand control of the hydraulic operating mechanism. Twenty-foot draft tubes give a total static head of 200 ft.

The wheels are direct connected to 2000 k. w. 6600-volt, 210 ampere, 375 r. p. m., type A. T. B., General Electric alternators with water cooled bearings. The general arrangement of these two units are shown in the interior view of the power station, Fig. 5. Exciting current is furnished by two direct current General Electric dynamos, type M. P., 6 pole, 800 ampere, 125-volt, driven at 750 r. p. m. by 16-in. Victor wheels under 180 foot head and controlled by Sturgess governors.

The switchboard consists of three generator panels (one being blank), two exciter panels, a lighting panel and panels for the No. 1 and No. 2 transmission lines. Each of the generator panels are equipped with one kilo-volt meter, one indicating wattmeter, one recording wattmeter, one ammeter, control for oil switch, field switch, meter switch for water wheel governor and synchronizing plug. Each of the exciter panels are furnished with an ammeter, voltmeter, a double-throw switch for the generator fields, bus and the lighting bus, and a motor control switch for the governor. The lighting panel is equipped with connections to control the crane and lights as well as the induction motors operating the water rheostat. These are operated at 110 volts, a small transformer being installed for their use. On the transmission line panels

**Fig. 5. Interior of Plant During Construction.**

are mounted three ammeters, two time-limit relay switches, a trip-coil, control oil switch with automatic trip and telltale gong. In addition there are two Tirrill regulators. Slate panels are used throughout.

Oil disconnecting switches are interposed between the switchboard and transformers. These are four in number, water cooled, 25 cycle, 850 k. w., raising from 6600 to 33,000 volts. They are connected in △ on the low voltage and Y on the high. Multi-gap lightning arresters are placed on the outgoing lines.

One of the most novel features in this plant are the two large water rheostats located in the power house. They dissipate the excess current that will be returned to the system when the motors are running above speed down grade. Ultimately, in case of double track and further extensions, such excess current would be available to assist the locomotives going up grade. If this current is not utilized the generators will be driven as motors in synchronism with those on the locomotives. These rheostats consist essentially of two concrete tanks, 6 x 9 x 12 feet, filled with water into which three legs are automatically introduced or withdrawn, as the current fluctuates, by means of an induction motor control. They are also expected to be of considerable use in taking care of the enormous load variations to which this plant will be subject.

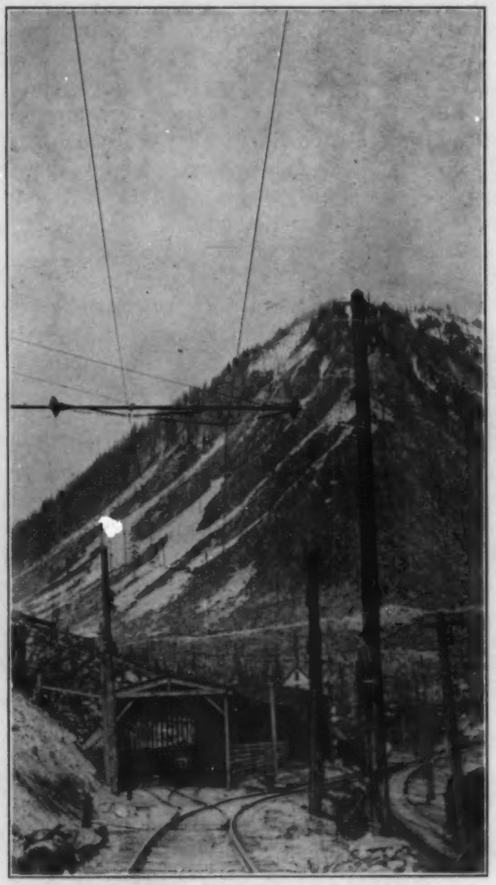


Fig. 6. Typical Outside Trolley Construction.

Fig. 7. Trolley Construction in Tunnel.

### Transmission.

From the power house the current is transmitted at 33,000 volts, 30 miles to the sub-station at the entrance to the tunnel. Wooden poles 35 feet high on which are mounted three cross-arms carry the two transmission lines. The three insulators for each three-phase line are arranged vertically, one below the other, 35,000 volt Locke insulators being used.

The sub-station transformers are connected in Y. on the high and in △ on the low voltage, oil disconnecting switches being provided for both high and low voltage. From the sub-station, current is fed at 6600 volts to the trolley line, which consists of two over-head wires the rail being employed as the third conductor. The normal trolley potential is 6600 volts, being transformed to 500 volts for use at the motors. Typical trolley construction in the tunnel and its approaches is shown in Figs. 6 and 7. The tunnel will be electrically lighted.

### Locomotives.

The locomotives are four in number, Fig 8 showing one of them as it stands without the tunnel. Each locomotive is equipped with four 500 h. p., three-phase induction motors, double truck, two motors per truck. The secondary circuit of each motor is mounted on a shaft geared in the ratio of 1 to 4.28 to the locomotive axle. The motors are wound for eight poles, and when operated at 25 cycles are driven at a speed of 375 r. p. m. in synchronism with the generators. Control is of the usual type M, Sprague General Electric, with independent switchboard, the motors being equipped with slip rings for plain rheostatic control.

This method of control was adopted because

of its simplicity as compared with cascade operation of the motors or with changing the number of motor-poles. There are four sets of contactors, with 14 contactors per set, four of which are used for reversing.

Duplicate control equipments are placed at both ends of the locomotive in the motorman's cab, leaving the center of the car to contain the step-down transformers, contactors, air compressors, switchboard, etc. A wide aisle is thus left on all sides of the center compartment which is equipped with metal doors. Each locomotive is 45 feet over-all and weighs 115 tons. The wheels are five ft. in diameter with 11 ft. rigid wheel base so that all curves can be easily taken.

**Fig. 8. Three-Phase Electric Locomotive Used in Cascade Tunnel of Great Northern Railway.**

Two-coil, air-cooled transformers step the current from 6600 down to 500 volts. A centrifugal blower, driven by a three-phase induction motor, supplies air for cooling the transformers, speed-controlling rheostats and motors. The transformers are connected in Y on the primary and $\wedge$ on the secondary. Air at 135 pounds pressure is supplied by motor-driven compressors and stored in three reservoirs, supplying the train-pipe as well as locomotive control.

Four trolleys are provided, two at either end of the locomotive, which take current from the two trolley wires for operation in either direction. During starting these will take current at 6600 volts, which will drop to 6000 volts under normal operating conditions.

Some of the reasons for the adoption of this innovation in traction work, as well as a comparison with foreign practice are given in the editorial comment on three-phase electrification. Suffice it to say here that a number of test runs have already been successfully made under the direction of Dr. Cary T. Hutchinson, the consulting engineer under whose supervision the installation has been made by the engineers of the General Electric Company and of the Great Northern Railway. As a substitute for the intolerable conditions existing in a three-mile tunnel where three locomotives belch forth great volumes of smoke in pulling a heavy freight train up grade the electric locomotive will give grateful relief. As to the general adaptability of three-phase locomotive for traction service opinion must be reserved until Doctor Hutchinson has presented a paper before the American Institute of Electrical Engineers.

## LIMITATIONS IN HYDRO-ELECTRIC TRANSMISSION.[1]

BY R. J. C. WOOD.

In developing a hydro-electric transmission, it will generally be found that the hydraulic constants are somewhat closely determined by natural physical conditions, so that the available head will be fixed, and not amenable to engineering manipulation. The determination of the maximum capacity of canals and power house equipment calls for the settling of a very nice question. Our rivers are extremely variable in flow, both from month to month and from year to year, so that a steam auxiliary plant is almost a necessity. If the stream is very highly developed, the auxiliary will have to be of larger capacity, and vice versa.

To make any intelligent design possible, stream flow measurements should be available for many years, ten years is none too short a time. From these the proportion between hydraulic and steam capacities can be determined so as to make the average cost per k. w. hour a minimum. It will be found that this proportion will depend upon the load factor, which is the ratio of average to peak loads. The most economical result will be obtained when the annual load factor of the steam plant is between 10 and 20 per cent, the exact figure depending upon the particular case.

In working out such a design, fixed charges upon investment and depreciation must be included in the cost of power. The question is further complicated by the nature of the market for the power. A project for which had all the output was contracted in advance would be laid out on more liberal lines than one which had to work up a market, though this latter would be designed with the possibility of final extension to a system comparable with the former. There can therefore be no definite rule as to the relative proportions of hydraulic and steam power; each case is a law unto itself.

The hydraulic head will probably settle whether reaction turbines or impulse wheels are to be used, somewhere around 300 to 400 feet being the dividing line. For the heads that we mostly have to deal with on the Coast, the impulse wheel is the type to be considered.

In the impulse wheel, there are certain definite relations between head, speed and horsepower which limit the output per runner

If H = head in ft.
v = spouting velocity
A = cross sectional area of jet
d = diameter of jet
D = diameter of wheel
k K = constants

$$\text{h. p.} = \frac{62.4\ v\ A\ H}{550}$$

Making substitution of $v = 8.02\sqrt{H}$

h. p. $= 0.91\ A\ H^{1.5}$ at 100% efficiency.

For the maximum size buckets, that is maximum h. p., and for given entrance and exit angles corresponding to a certain efficiency the size of the buckets will bear a constant ratio to the wheel diameter, the

[1]Paper read at February meeting Los Angeles Section, A. I. E. E.

diameter of the jet will therefore also be proportional to the wheel diameter. Therefore

$$A = k D^2$$

Taking the peripheral wheel velocity to be 45% of the spouting velocity

$$D = \frac{0.45 \times 60 \times 8.02 \delta H}{\pi \times \text{r. p. m.}}$$

Substituting

$$\text{h. p.} = \frac{4320\, k\, H^{2.5}}{\text{r.p.m.}^3} = \frac{K H^{2.5}}{\text{r.p.m.}^2}$$

K is constant which varies according to the efficiency that is desired. Taking 80% as an average efficiency, K will equal about 16 for a two-wheel unit, or transforming this relation into kilowatts, with a generator efficiency of 96%,

$$\text{k. w.} = \frac{25\, H^{2.5}}{\text{r.p.m.}^2}$$

If P = number of poles of generator
N = frequency
Z = k. w. output for pole revolution per minute

$$P = \frac{120\, N}{\text{r. p. m.}}$$

$$\text{k. w.} = Z\, P \times \text{r. p. m.} = 120\, Z\, N$$

For 50 cycle machines, Z = 2 is a somewhat high figure.

It will thus appear that the limitation to maximum size of wheel and generator unit is determined by the output per pole per r. p. m. of the generator, and that for 50 cycle three phase machines, 12000 k. w. is about the maximum.

As an illustration:

Suppose the head = 2000 ft.

| | |
|---|---|
| r. p. m. | 600 |
| k. w. | 12,500 |
| Dia. of wheel in ft. | 5.14 |
| No. of poles | 10 |
| k. w. per pole | 1,250 |

For a head of 300 ft.

| | |
|---|---|
| r. p. m. | 56.6 |
| k. w. | 12,100 |
| Dia. of wheel in ft. | 21.1 |
| No. of poles | 106 |
| k. w. per pole | 114 |

This gives the probable extreme range that will be met.

It is interesting to note that there is also a minimum size of water wheel for any given head. This arrives from the centrifugal force on the buckets being proportional to $\frac{v^2}{R}$ v being the peripheral velocity and R the radius of wheel. For a fixed head, v is constant for all sizes of wheel, so that as the wheel is made smaller and smaller, the centrifugal force becomes larger. At the limit of safe stresses in materials, the limit of minimum wheel size is reached.

From an operating standpoint, it does not seem judicious to have less than four units in the station, so that for projects up to 48,000 total k. w., there is no call for larger machines than the 12,000 k. w. mentioned above.

Coming now to the control of such large units, there is no difficulty in getting switches large enough. In any case since there will be switches handling the whole station output, it must necessarily be possible to control the separate units.

For the transformation of the energy to high voltages, there is apparently no size limit. Transformers of 10,000 k. w. have been built for 110,000 volts with an efficiency of over 99%, and there is no objection to banking any number except as to the space occupied.

It requires a very daring man, or a prophet, to place any definite limit to the possible voltage of transmission. Twenty years ago, a voltage of 30,000 seemed Utopian, even if it were ever considered. As far as the mere possibilities of insulation are concerned, about 500,000 volts seems to be the present limit for which a transformer can be wound, and at this voltage the dimensions of the apparatus become very large and its operating qualities poor. It does not seem necessary to consider such an extremely high tension, for, as will be shown, very large quantities of power may be transmitted great distances at much lower voltages.

In considering the design of the transmission line, there are such a number of things that may be varied to suit the engineer, that in order to get any broad idea of what can be done, we must first assume some of the constants arbitrarily.

For the average transmission, a power loss of 10% will come close to representing the most economical condition. A line regulation of 20% will be assumed for 80% power factor. This will mean a regulation of about 30% when transformers are included. This is as high as should be permitted and will call for all the field regulation that the average generator possesses. The charging current of the line becomes very large with long circuits and high voltages, and the condition will be made that it equals 0.75 of the load current as the upper limit. This will enable one generator out of four to be shut down for cleaning and repairs without burning up the remaining machines with the charging current.

The distance between cables will be 72 inches, and it may be noted that a considerable departure from this distance will have very little effect on the line.

We may then take—

x = reactance per mile = 0.01184 N

$$r = \text{resistance per mile} = \frac{55900}{\text{c. m.}}$$

$I_c$ = charging current per mile = $5.62\, E\, N\, 10^{-8}$
L = length of line in miles
E = voltage between lines
c. m. = circular mils

In order that the voltage drop shall be 20% at .80 power factor and the power loss = 10%, there must be this constant relation:

$$I\, r = \frac{0.12\, E}{1.732}$$

$$I\, x = \frac{0.34\, E}{1.732}$$

It has also been stipulated that $I = 1.33\, I_c$

Then

$$I\, x = 8.88\, E\, L^2\, N^2\, 10^{-10}$$

Whence

$$L = \frac{14870}{N}$$

Also

$$I\,r = 0.0692\,E$$

Whence

$$I = 0.00111\,E$$

$$\text{c. m.} = \frac{13380000}{N}$$

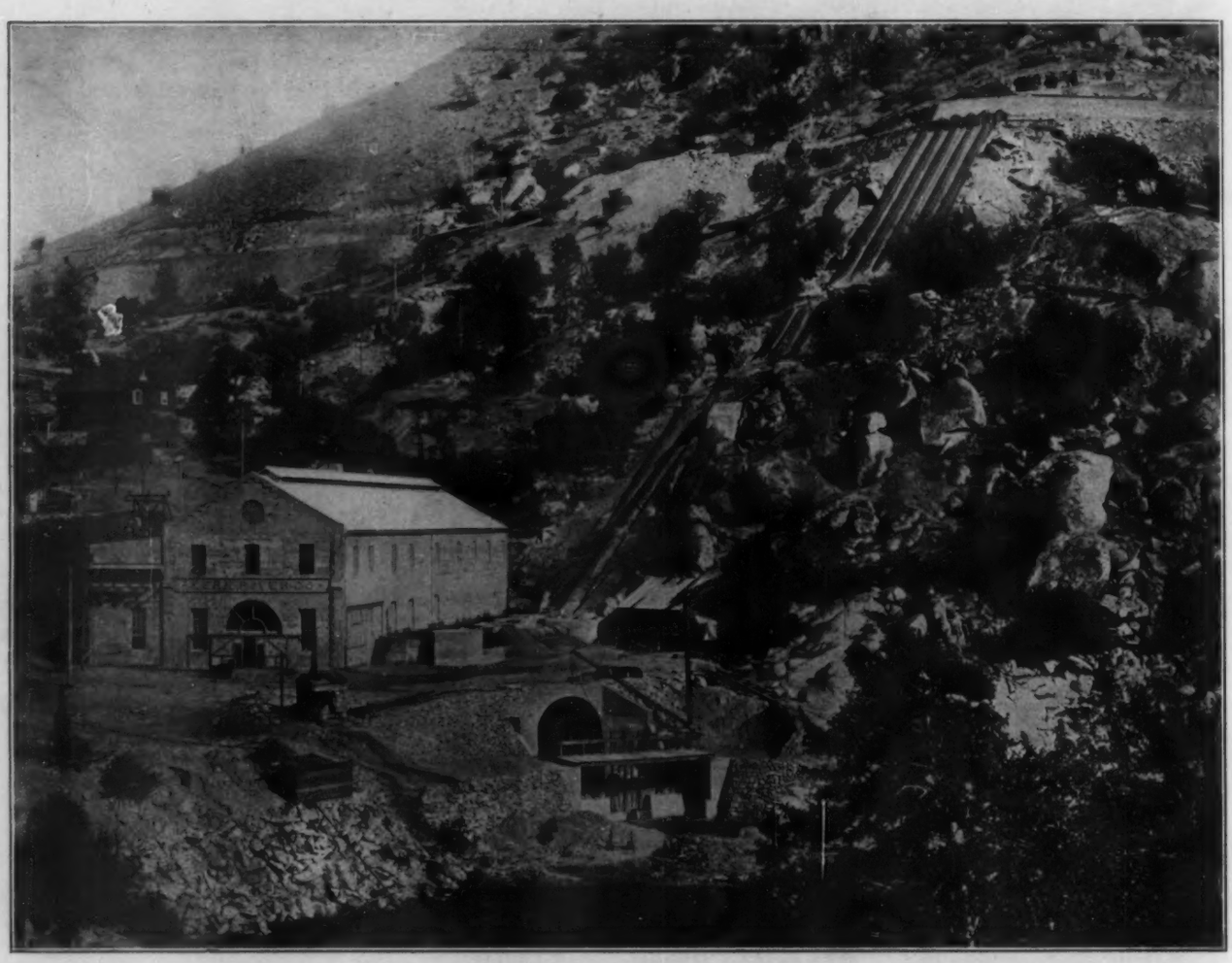
Taking all these quantities as fixed, it will be found that the size of cable and possible distance of transmission depend solely upon the frequency. For any given voltage the load amperes are the same for any frequency. The k. v. a. transmitted are proportional to the square of the voltage.

The following table is worked out:

| For a voltage of 100,000: | | | | | |
|---|---|---|---|---|---|
| Frequency ..... | 15 | 25 | 50 | 60 | Cycles |
| Distance ..... | 994 | 595 | 298 | 248 | Miles |
| k. v. a..... | 19,200 | 19,200 | 19,200 | 19,200 | |
| Size of cable.... | 891,000 | 535,000 | 267,000 | 223,000 | c. m. |
| Cost of copper @ 20c ..... | $8,560,000 | $3,080,000 | $768,000 | $534,000 | |

In order to make the 1000-mile transmission a financial possibility, the voltage would have to be raised to about 300,000 volts, which would enable 180,000 k. v. a. to be transmitted, and would bring the cost of copper down to $47.50 a k. v. a.—a reasonable figure. This also shows that for the same cost of copper per k. v. a., the power to be transmitted should vary as the square of the distance.

At this point it becomes necessary to consider the natural period of oscillation of the line. Should this be either approximately the same, or three times the frequency of generation, with certain forms of transformer connections, there might be serious trouble from resonance. The natural period is given by



**Typical Water Power Development in California.**

$$N = \frac{46800}{L}$$ where L is in miles.

The natural period of the lines already discussed is very close to that of the triple harmonic, so that it might be necessary to shorten the distances given above. Making the natural frequency 20% greater than that of the third harmonic, the maximum distances work out to:

| Frequency ..... | 15 | 25 | 50 | 60 |
|---|---|---|---|---|
| Distance ..... | 867 | 520 | 260 | 216 |
| k. v. a..... | 22,000 | 22,000 | 22,000 | 22,000 |

To put this all in a form easily remembered, it may be stated in round numbers that—

The product of frequency and distance should not exceed 13,000.

The maximum k. v. a .transmittable to maximum distance is 22,000 at 100,000 volts, and is proportional to the square of the voltage.

In line construction, there very soon comes a limit to the economical length of span. The sag that has to be given to the conductor is very nearly proportional to the square of the span, so that as the span is increased, the height and cost of towers increases more rapidly than their number diminishes. The actual span proving the most economic will depend upon the cost of materials and of setting the towers; it will probably lie between 400 and 800 feet for level ground. Where the natural conditions permit of placing towers upon adjacent hilltops, the permissable length of span will naturally be lengthened.

In calculating the required sag at different temperatures, it is necessary to take the elasticity of the cable into account. That this is a practical point is borne out by the fact that in a 700-foot span, the towers may be made some six feet lower than the common inelastic theory would indicate.

The reasoning is thus: Suppose the span is at a temperature of 30° F., it will be drawn up tight due to contraction, and may be stressed to, say, 20,000 pounds per square inch. Should the cable become heated to 100° F., it will expand and sag lower. According to the old theories, the cable was supposed to expand an amount proportional only to its temperature coefficient and the degrees of heating, but by the act of sagging more, the stress on the cable is reduced and may be only 16,000 now instead of 20,000 when cold. The result is that the cable shrinks a little due to the decreased stress and does not sag so much as was predicted by the inelastic theory.

As the size of the cable is diminished, the effect of wind upon it is more pronounced. While it is quite possible to string a No. 000 over 700-foot spans and have it safe under a 30-pound wind, it is impossible to hang a No. 10 copper telephone wire with the same span and sag and not have it blown down. The effect of sleet is not here considered; it is, however, to make it still worse for the small wire.

The figure previously taken, 10% for power loss, is of course arbitrary. The textbook way to determine the allowable line loss is by Kelvin's law, which is to the effect that it is economical to keep adding copper until the scale of the increase of power delivered just balances the fixed charges upon the increase of investment.

There is a better way of looking at this question. It is simply to put in enough copper to make a minimum total cost of development per k. w. delivered. For instance, suppose a generating plant of 50,000 k. w., costing $7,500,000 exclusive of copper on the line, further let the power loss be 13.3% with $500,000 worth of copper, this will make the total investment per k. w. delivered = $185.30. Is it worth while to spend $667,000 on copper instead of $500,000?

With $667,000 of copper, the power loss is 10% and the total cost per k. w. delivered will be $181.50 as against $185.30, or the delivered output has been increased 1770 k. w. at a cost of $167,000, or only $94.40 per k. w., and as this is less than the original investment per k. w., the additional $167,000 outlay is justified. In the case of plants on variable streams, this reasoning is to be applied to the costs per average k. w. delivered, the line loss being the average loss. This way of solving the problem at once gets rid of the difficulty of determining what the additional power is worth, and rates of interest and depreciation are eliminated.

## DEFINITION OF HEAD OF WATER.

In a recent paper Mr. Chas. T. Main, mill engineer and architect, of Boston, gives the following definition of "head" as applied in water power development.

"There is the legal head, or the head to which the owner has a right to develop his power. This may or may not have been developed to its full extent. It may be that the expense involved would be too great to warrant further development. In some cases it may be economy to make the expenditure necessary to get the benefit of some unused portion of the head

"The gross head is the head actually used for producing power and getting the water to and away from the wheel.

"The net effective head is the gross head minus the loss in head required to get the water to and away from the wheel. This loss will vary with the length of the waterways leading to and away from the wheels, the velocity of the flowing water, and the construction of such waterways.

"In several manufacturing cities where the water power is controlled by a company which is separate from the mill owners, there is an allowance of one foot made from the gross head before charging for the water as used on the wheels.

"The head should be measured with the wheels running. The only portion of the head which produces power is the difference in level directly above and below the wheel when the wheel is running."

**Asbestos** is finding a new field as a result of improved construction of electric railways. The need of an insulating material less brittle than glass and porcelain and more durable than rubber, has led to the adoption of new compositions which, with asbestos as the base, possess both tensile strength and heat-resisting properties.

**Danger from Ferro-Silicon** in transportation has led some steamship companies to refuse to carry it. The substance is a metallic powder formed in an electric furnace by heating a mixture of iron ore, quartz, lime and coke. When moistened it gives off gases, which are not only explosive if confined, but also dangerous to breathe. Among these is phosphoretted hydrogen, which, when mixed with air in the proportion of one part in 5000, is said to be fatal to small animals Deaths are alleged to have occurred among the crews of ships exposed to the emanations of this substance. But G. Watson Gray asserts that the danger can be avoided by careful methods of manufacture. If the silicon content is below 40 or above 60 per cent, the substance is comparatively harmless, but between these proportions it may be dangerous to transport. It should never be confined or hermetically sealed.

# JOURNAL OF ELECTRICITY
POWER AND GAS

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Changes of advertising copy should reach this office ten days in advance of date of issue. New advertisements will be accepted up to noon of Monday for the paper dated Saturday of the same week. Where proof is to be returned for approval, Eastern advertisers should mail copy at least thirty days in advance of date of issue.

FOUNDED 1887 AS THE
PACIFIC LUMBERMAN, CONTRACTOR AND ELECTRICIAN


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In the issue of July 31st will be published a description of the Wenatchee Electric Company's plant in Washington. George C. Holberton, engineer of electric distribution for the Pacific Gas and Electric Company, will write on "Co-operation Between Contractors and the Central Stations," and the stenographic report of the discussion by the members of the San Francisco Section, A. I. E. E., on "Electrolysis," will be published in full.


**New Engineering Societies**

Collective has succeeded individual specialization. The great arc of engineering practice, struck on the circle of human activity and cut into sections of civil, mechanical, mining and electrical engineering, has been further subdivided into innumerable tangent specialties. Mutual interest and co-operation bind these nuclui into an aggregate and we have a new engineering society. In the course of his annual address before the American Society of Civil Engineers, on the "Status of the Civil Engineer," President Onward Bates showed the diversity of the Society's membership and indicated the impossibility of all the papers and discussions interesting all members. The same is true of the technical periodical which aims to furnish some material that will interest most of its readers. It is necessarily a small minority that will find every issue of equal interest.

This is the argument used for the formation of new technical societies to which there seems no end. In the field of electrical engineering, we find subsidiary organizations devoted to electric traction, telephony, telegraphy, electro-chemistry, electro-therapeutics, contracting, operating, transmission, illumination and trades; every one of these being further limited as to locality. The latest addition to this galaxy is the Institution of Mining Electrical Engineers, just formed in London. Branch sections are to be established in every mining district and it is hoped that the society will eventually be world-wide.

The objects of these societies are commendable and their effect is beneficial so far as they do not tend to narrow and deepen the groove of isolation in which the specialist burrows. Some broadening influence is essential to co-ordinate his work and prevent mental warping. He can appreciate his own function in the plan of the universe only by coming in contact with others.

---

**Limitations**

Progress is the gust of wind that scatters the modern sibylline leaves. Today's prognostication is disproved by tomorrow's discovery, and he is a bold man who dares circumscribe future development by present condition. The free wild life of a new mining camp brooks no limit on its gambling, nor is it safe to too closely define the possible. Modern investigation which shows that energy, closely allied to electricity is the basis of all matter, and that the ether vibration recognized as light differs from the wireless telegraph wave, the heat wave and the X-ray only in amplitude and frequency, may soon find some means of generating and transmitting electric power that will make present methods seem crude and puerile. Judging from the universality of the expression "electricity is yet in its infancy," to this force may well be assigned the characterisics of perpetual youth. When we read that the pressure of light can counteract the attraction of gravitation and that the

sun causes the earth's magnetic field, we realize that Franklin only pointed out the trail to the goal.

These high flown ideas do not tax the elastic limit of our imagination as much as would our present knowledge bewilder Archimedes. The final analysis of any scheme ultimately resolves itself to a matter of dollars and cents. But the day will come when the market price of copper will have as little bearing on the cost of electric current as is now exerted by Voltas' electrophorus, which was beaten with a cat's skin. Though almost as intangible as a chimera revolving in a vacuum, these ideas reveal that the puny limit set by financial confidence is but a temporary restraint to illimitable probabilities and infinite possibilities.

---

**Three-Phase Railway Electrification**

The tremendous increase in productive activity of farm, forest and mine during the past decade has so greatly over-taxed the carrying capacity of our railroads as to make imperative some radical remedy to care for future expansion. The condition is bad enough when ore and lumber are kept waiting their turn, but when perishable fruit rots at shipping points because there are no means for taking it where it is needed, the situation warrants immediate attention. Temporary relief has been afforded in some instances by increasing the number of cars, but there yet remains the difficulty of moving these cars over tracks already congested. This congestion centers at railway terminals and over mountain divisions where traffic movement is limited by locomotive capacity. Any method that will remove these unhealthy and excessive accumulations at barrier points will go far to reduce the general incapacity.

The remarkable success of urban electric traction suggested to thinking railway men a few years ago that electric operation of their own trains would increase their capacity and reduce their operating costs. As a consequence some of our most brilliant electrical engineers have turned their attention to this matter and a number of railways have been electrified, either in whole or in part, and many others are contemplating similar action, as they see the success of their more courageous contemporaries. The economics of the matter have not yet been presented because of its recentness, but in general it may be conservatively stated that the aggregate of delay has been less than with the old steam service, and that the power necessary has been greatly minimized.

Three types of motors have been utilized for this purpose. The direct current, as exemplified in the New York Central lines, the single phase alternating current as employed for instance by the New Haven road, and now the three-phase alternating current being used by the Great Northern Railway in electrifying its tunnel through the Cascade mountains in northern Washington. The first two systems have successfully weathered both the commendations of their adherents, and the criticisms of their opponents. The latter method is untried in this country and the outcome of its experimental test is being awaited with interest. With regard to their comparative merits no one of them has so greatly excelled the other as to make it universally applicable, but each possesses certain advantages in its own field.

For comparative data on three-phase electrification we must go abroad. Ten years ago thirty miles of the Burgdorf-Thun railway disproved predictions as to its failure because of wasteful speed control, low power factor, double trolley and small motor clearance, by a record of 51 watt hours per ton mile of passenger train and 46 watt hours per ton mile of freight train at an average operative cost of .052 cents per ton mile. Three years later the matter was still further clinched by the successful construction and operation of the Valtellina 67-mile electrification, and again in 1906, by the electrification of the Simplon tunnel, 12½ miles in length.

The Cascade tunnel electrification differs from these in several esesential details. It employs a trolley voltage of 6600, as compared with the 750 volts of the Burgdorf-Thun, and the 3000 volts of the Valtellina and the Simplon installations. The rheostatic speed control also differs from the concatenated of the Valtellina and the control by changing the number of poles in the Simplon. The Valtellina motors are joined so that the secondary of the first motor is connected to the primary of the second, thus giving full efficiency of operation at either full or half speed, according as the motors are tandem or in parallel. The Simplon locomotives are equipped with two motors so wound that the number of poles can be changed from eight to sixteen. Both these methods of speed control add further complications to an involved system. The energy wasted by rheostatic control is furnished by water that otherwise goes over the dam, as there is no method of storage available and the greater simplicity of equipment more than compensates for this minor loss.

The three-phase motor is a constant speed machine and runs in synchronism with the generators, giving small slip even when greatly overloaded. Locomotives thus equipped can run up grade nearly as fast as on the level and when running above speed or down grade they act as induction generators, returning energy to the supply system and also limiting the speed by their braking action. Normally this returned energy could be utilized by other locomotives in the system, but in the Great Northern experimental plant it is dissipated by means of a specially designed water rheostat. The motors are geared so as to give a speed of 15 miles on the up grade, which speed is but slightly exceeded on the down.

Further comparison should be reserved until the engineers have an opportunity to test the equipment and present their story to the engineering public. Upon the success of this tunnel electrification depends similar service not only for the mountain divisions of this road, but also of many others. The outcome of these experiments will therefore be eagerly awaited.

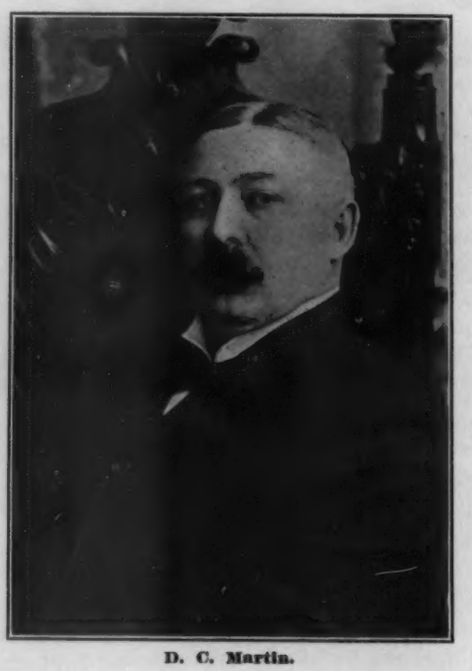
# JOURNAL PORTRAITS

## D. C. MARTIN.

D. C. Martin, who has been associated with Fairbanks-Morse & Company at San Francisco for the past three years in charge of the pumping machinery department of that company, is one of the best known marine and stationary engineers upon the Pacific Coast.

Mr. Martin is a native of California and served his apprenticeship in the Risdon Iron Works of San Francisco, both in the drafting room and the machine shop. Following this apprenticeship he cast his lot in the marine service with the Pacific Mail Steamship Company on the steamship "Tokio" under the late deceased Superintendent and Chief Engineer, S. W. Hauxhurst.

Following this experience and with a desire to enter a broader field he journeyed to Philadelphia where he joined the force of the William Cramp & Sons Shipbuilding Company, who had under construction at that time the two well known steamers "Alameda" and the "Mariposa" for the Oceanic Steamship Company. On the completion of the work on these steamers, Mr. Martin joined the steamship "Alameda" as First Assistant Engineer, sailing for the port



D. C. Martin.

of San Francisco via the Straits of Magellan. The "Alameda" during this trip made the remarkable time of 45 days —a record which has never been surpassed.

His marine experience also included service on the Pacific Mail Steamship Tokio, and he was engaged in this work when General U. S. Grant made his return trip on the Tokio to the United States on the completion of his famous tour of the world.

During the early days of cable railroading in San Francisco, Mr. Martin handled some important work in connection with the old Tenth and Howard street line under the well-known Chief, Chief Engineer G. H. Fairchild.

In addition to his engineering work he has had a varied experience as a salesman, which included four years with the John A. Roebling's Sons Company, during which time he covered California, Nevada and Arizona. He also handled the line of the Smith-Vaille Company, manufacturers of pumping machinery, and the rubber goods line of the Boston Woven Hose and Rubber Company.

Mr. Martin has for some years been an active member of San Francisco No. 35, Marine Engineers Benevolent Association and during his service with this Association has acted as delegate to numerous National Conventions held in the East, including Washington, Baltimore and Charleston.

---

## PERSONALS.

C. D. Wheeler has been appointed advertising manager of the Fort Wayne Electric Works.

L. Heyneman of the Goldschmidt Thermit Company, San Francisco, was in Los Angeles last week.

W. A. Blair, assistant treasurer of the Western Electric Company, is now in Salt Lake City and will return early next week.

P. H. Riordan, manager of the Compressed Air Machinery Company, San Francisco, who has been turing the east, has returned.

George R. Murphy, Pacific Coast engineer of the Electric Storage Company, is making an extended trip throughout the Northwest.

W. J. Davis Jr., electrical engineer for the General Electric Company on the Coast, left last week for a month's business trip to New York.

Francis P. Bergen, electrical engineer, of San Francisco, who has been in New York and Philadelphia the past month, is expected to return August 1st.

Julius Beeman of Portland, Ore., Coast representative of the Alamo Gas Engine Company of Hillsdale, Mich., has been in San Francisco the past week.

E. C. Bradley, vice-president and general manager of the Pacific Telephone and Telegraph Company, San Francisco, will leave for a three weeks' trip to Honolulu on August 5th.

R. D. Holabird of the Holabird-Reynolds Electric Company, San Francisco, has been spending the past two weeks at Klamath Falls on a fishing trip. He will return on July 26th.

F. F. Wear, Pacific Coast manager for Hobart Electric Company, who has been making an extended business trip in the East and on the Coast, is expected home about August 1.

C. C. Manker, sales manager of the lamp department of Parrot & Company returned to San Francisco July 15th from a business trip to Seattle, Portland and the Pacific Northwest.

G. A. Schneider of the power apparatus department of the Western Electric Company at San Francisco, who has been seriously ill for the past two or three months, has so far recovered that he is able to resume his duties.

W. L. Goodwin of the Sterling Electric Company, San Francisco, who has been on an enforced vacation of two weeks as a result of illness, has so far recovered that he is now able to spend one or two hours a day at his office.

H. V. Carter, president and general manager of the newly organized Pacific States Electric Company, spent the past week in San Francisco. Mr. Carter's plans provide for his permanent location at San Francisco within the near future, from which point he will direct the work of the newly organized company.

F. H. Wilkins, supervisor of branch houses of the Western Electric Company, whose headquarters are in New York, spent the early part of this week in San Francisco and left for Los Angeles on July 22nd. He will return to San Francisco next week and after a brief stop of two or three days will return East by way of Portland and Seattle.

## NEWS OF THE STATIONARY ENGINEERS.

**PREAMBLE.**—This Association shall at no time be used for the furtherance of strikes, or for the purpose of interfering in any way between its members and their employers in regard to wages; recognizing the identity of interests between employer and employe, and not countenancing any project or enterprise that will interfere with perfect harmony between them.

Neither shall it be used for political or religious purposes. Its meetings shall be devoted to the business of the Association, and at all times preference shall be given to the education of engineers, and to securing the enactment of engineers' license laws in order to prevent the destruction of life and property in the generation and transmission of steam as a motive power.

**California.**

No. 1. San Francisco. Thursday, Central Hall, 124 Fulton St. Pres., A. C. Arbuckle. Sec., Herman Noethig, 900 York St.
No. 2. Los Angeles. Friday, Eagles' Hall, 116½ E. Third St. Pres., Gabriel Allen. Fin. Sec., Harry Notthoff, 1307 Winfield St. Cor. Sec., W. T. W. Curl, 4103 Dalton Ave.
No. 3. San Francisco. Wednesday, Merchants' Exchange Bldg. Sec., David Thomas, 914 O'Farrell St.
No. 5. Santa Barbara. Geo. W. Stevens, 2417 Fletcher Ave., R. R. No. 2.
No. 6. San Jose. Wednesday. Pres., W. S. Pierson. Sec., Leal Davis, 350 N. 9th St.
No. 7. Fresno. Pres., J. F. Wagoner. Sec., F. J. Whitney, Box 8.
No. 8. Stockton. Thursday, Masonic Hall. Sec., S. Bunch, 626 E. Channel St. Pres., Jos. Gieger.

**Oregon.**

No. 1. Portland. Wednesday, J. D. Asher, Portland Hotel. Pres., O. H. Reed.
No. 2. Salem. A. L. Brown, Box 166.

**Washington.**

No. 2. Tacoma. Friday, 913½ Tacoma Ave. Pres., Geo. E. Bowman. Sec., Thos. L. Keeley, 3727 Ferdinand St., N., Whitworth Sta.
No. 3. Walla Walla. 1st and 3d Wednesday, German Hall. Pres., W. M. Quinn. Sec., O. L. Compton, Box 11.
No. 4. Spokane. Tuesday. Pres., Grant Tuttle. Sec., J. Thos. Greeley, 0601½ Cincinnati St.
No. 6. Seattle. Saturday, 1420 2d Ave. Pres., J. H. Beckman. Sec., J. C. Miller, 1600 Yesler Way.

**Practical letters from engineers and news items of general interest are always welcome. Write your items regardless of style. Communications should be addressed to the Engineering Editor.**

### SAN FRANCISCO NO. 1.

The largest class initiation ever held by any association throughout the State will be held by San Francisco No. 1 on Thursday evening, July 29th. It is expected that there will be over twenty-five new members taken into the Association and a cordial invitation is extended to every member to attend.

### SAN FRANCISCO NO. 3.

San Francisco No. 3, N. A. S. E., met in their new quarters, room 239, Merchants' Exchange Building, on July 14th. The room has been cozily furnished and is open to the members at all times.

A number of technical books have been donated to the library, forming the nucleus of what promises to be a most complete array of works of reference. Secretary Thomas was appointed librarian.

Four applications for membership were received.

President Arbuckle and Vice President Ennor of San Francisco No. 1, were visitors, together with Brothers Daniells, Gaskill and Keuhl, the committee on entertainment appointed by the president of No. 1 to confer with a like committee from No. 3 for the purpose of arranging a joint meeting of both associations to receive the final report of the general committee on arrangements of the Convention and Mechanics' Fair held in June. The committee from No. 3 is made up of Bros. Saville, Ostrom and Lawrence.

The committee, after a conference, reported that Bros. Daniells and Gaskill had been elected chairman and secretary, respectively, and that the joint meeting would be held at the rooms of the mother association, No. 1, on July 29th. This meeting promises to be a notable event in the annals of the N. A. S. E. in San Francisco, and all members are urged to attend, to do honor to the committee whose sterling qualities have been proven so conclusively. Refreshments and reminiscences will be in order after the formalities are disposed of.

Announcement will be made at a later date of a lecture to be given before the members of San Francisco No. 3 by Prof. W. F. Durant, dean of the department of mechanics of Leland Stanford University, the topic to be one of exceptional interest to the engineers; ample notice of this lecture will be given by the secretary of No. 3 and all N. A. S. E. members and friends will be cordially invited to attend.

### BUILDING LIGHTING.

One of the most important features of office building equipment and management is that of properly and efficiently lighting the various rooms of which it is composed. Too often we find that the fixtures are located without regard to the proper distribution of the light, resulting in an unsatisfactory condition of light diffusion and the necessity of increasing current consumption far above what would be necessary if fixtures were located in accordance with a scientific examination of all the factors entering into the problem. While it is universally conceded that tungsten, tantalum and metallized filament lamps are infinitely superior to the standard carbon filament lamps in light diffusion and current consumption, there is grave doubt in the minds of many engineers as to the relative cost of the two types of lamps when the frailties of the newer types are considered. Realizing that many engineers in charge of building equipment have not had the opportunity to post themselves in regard to these problems we urge the members of the N. A. S. E. to make the fullest use of the "question box" at all meetings, and we promise the most careful consideration of any questions found too complex for the local associations, which may be submitted to us.

WM. P. MILLNER
H. D. SAVILLE,
State Educational Committee, N. A. S. E.

### ORGANIZATION OF THE PACIFIC STATES ELECTRIC COMPANY.

The Pacific States Electric Company recently incorporated under the laws of the State of California, and which has taken over the business and property of the Sterling Electric Company of San Francisco, the Pacific Electrical Works of Los Angeles and the Crescent Electric Company of Oakland, completed its organization under date of July 19th.

The original arrangement provided for taking over the business of the Brooks-Follis Electric Corporation of San Francisco in addition to the three houses referred to above, but as this feature of the arrangement could not be consumated, the Brooks-Follis Electric Corporation will continue in business as in the past.

The organization of the new company is as follows:

H. V. Carter, W. L. Goodwin, J. C. Gilson, F. J. Quinn and John S. Eells, Directors; H. V. Carter, President and General Manager; J. C. Gilson, First Vice-President; W. L. Goodwin, Second Vice-President; F. J. Quinn, Secretary and Treasurer.

The business organization, in addition to H. V. Carter, General Manager, will include W. L. Goodwin as Sales Manager for the company; F. J. Quinn, Manager of the San Francisco house; C. S. Gilson, Manager of the Oakland house, and C. H. Carter, Manager of the Los Angeles house.

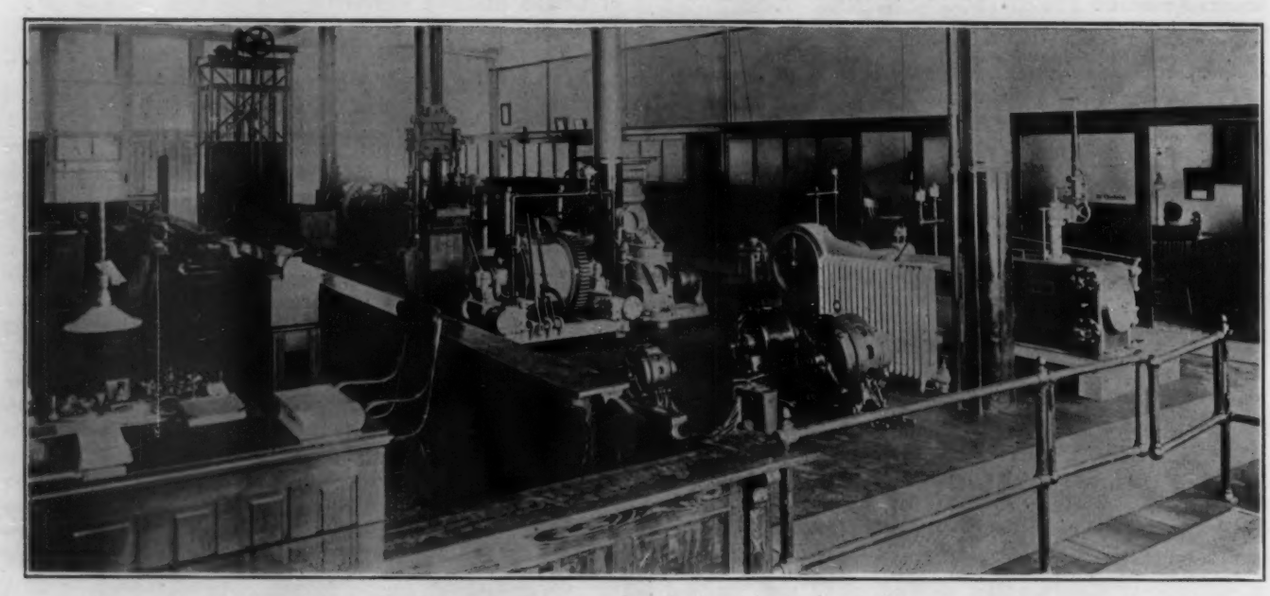
H. V. Carter as President and General Manager will make his headquarters at San Francisco and direct the work of the company from that point.

The company anticipates operating under their new name within the next ten days or two weeks.

# INDUSTRIAL

## ALLIS-CHALMERS COMPANY.

### An Outline of their Organization on the Pacific Slope.



**Allis-Chalmers Company. Interior View of Offices and Sales Room at Salt Lake City.**

In view of the improved conditions in the manufacturing business during the past few months and in anticipation of the general resumption of business in the near future, the Allis-Chalmers Company, through reorganization and by numerous additions to their selling force, have materially strengthened their organization on the Pacific Slope and feel that they are now in position to secure their full share of the business in this rapidly developing territory.

The entire country west of the Rocky Mountains is now thoroughly covered by district warehouses and offices located at San Francisco, Los Angeles, Seattle, Portland, Salt Lake City and Spokane. Considering the large general stock carried by this company amongst these district warehouses, any order calling for standard apparatus can be quickly filled from one stock or another.

**Allis-Chalmers Company, San Francisco House.**

The hydraulic turbine and hydro-electric negotiations in the above territory will be handled by Edward G. Dewald, formerly manager of the Platt Iron Works Company of Dayton, Ohio, who is too well known on the Coast to require any extended introduction. Mr. Dewald has been with the Platt Company for the past twenty years, during five of which he served as manager of its San Francisco office; and he has been identified with many of the largest hydraulic power installations in the country, including the majority of those on the Coast. His prominence in this field, therefore, coupled with the extraordinary success of the Allis-Chalmers Company in the design and sale of hydro-electric machinery, gives especial significance to the new connection which he has

**Allis-Chalmers Company. Interior View of San Francisco Office.**

made. Under his direction the customer will be furnished with a combined bid on hydraulic turbine and electric plant built at one factory, under one roof, and undivided responsibility, and built to suit the conditions of the customer.

**Allis-Chalmers Company. Interior View of Los Angeles Office.**

The Allis-Chalmers Company's combined unit brings with it, and has as its basis, the generating of the maximum power from the customer's conditions, and not the adaptation of the nearest stock wheel which will work.

The Allis-Chalmers Company are the only water-wheel builders who have facilities for manufacturing complete hydro-electric units.

The uses of many standard lines of machinery manufactured by this company are being extended into new fields, and the grinding and separating machinery, used in the world's famous Allis-Chalmers Flour Mills, now find an extended sale in the treatment of ores and other operations.

The sand lime brick process offers a new field for the same cylinders, which are used in the Allis-Chalmers timber preserving plants. One of the latest fields to be invaded is the sugar industry—both cane, beet-root and other sugar machinery will now be part of the regular products of the Allis-Chalmers Company.

The San Francisco district office is located on the ground floor of the Phillips Building, corner of Second and Mission streets, in charge of R. B. Elder as acting manager. This organization includes five sales engineers at present, a force that is to be considerably augmented.

**Allis-Chalmers Company, Los Angeles House.**

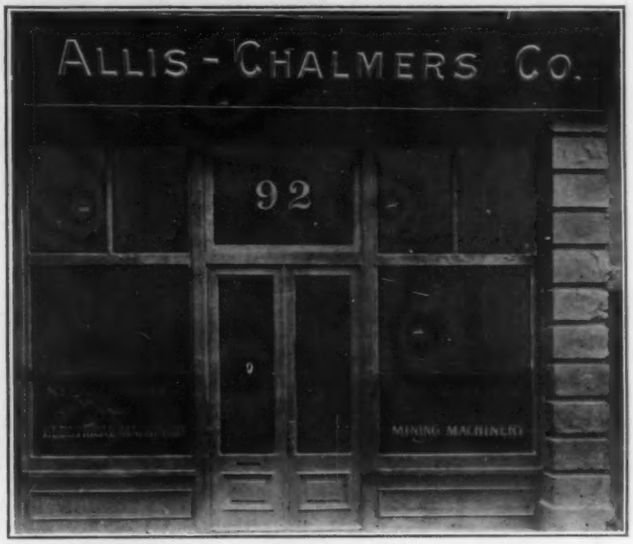
E. W. Lindquist of this office is from the staff of engineers, mining machinery department, at Milwaukee, at which point he was in charge of the drafting room. He is a specialist devoting his entire attention to mining machinery engineering.

C. J. Muller, formerly with the San Francisco office of the Westinghouse Electric and Manufacturing Company, has been with the Allis-Chalmers Company since 1905, and specializes in crushing and electrical apparatus.

Among the recent additions to the selling organization of this office may be mentioned G. B. McLean, recently associated with the sales staff of Charles C. Moore & Co., San Francisco, and H. C. Thaxter, a well-known sales engineer of San Francisco.

A large stock of crushing machinery, air compressors, air-brake apparatus and electrical machinery is kept on hand at this point.

The Los Angeles office of the Allis-Chalmers Company has been moved to a ground floor location at 129 East Fifth street, where ample accommodations are provided for a large electrical stock, to which a stock of other lines will be added as the demand requires.




**Allis-Chalmers Company, Portland. (Ore.) House.**

In line with the feeling of confidence by the Allis-Chalmers Company of the business future on the Pacific Coast, general strengthening of the commercial and engineering forces of this office is being carried out.

The Los Angeles office is in charge of W. S. Heger, formerly assistant to the president of the Allis-Chalmers Company. Mr. Heger returns to the Coast after a four years' absence at the main office of the company in Milwaukee.

Associated with Mr. Heger is Charles Farnham, formerly connected with the Edison Electric Company of Los Angeles, in the power contracting department of that company, and E. H. Knepper, formerly of the Ingersoll Rand Company, who handle respectively the electrical and mining branches of the company's business.

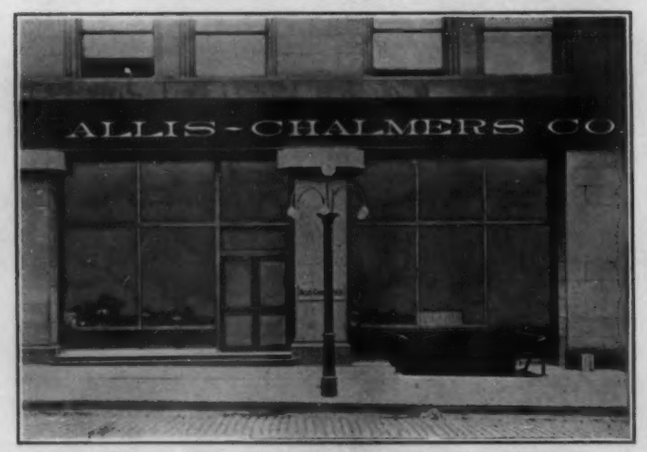
Both of these lines will be strengthened by the addition of two of the best known men in these lines in California, whose appointments will be announced later.

The Northwest business is handled from Seattle and Portland, the latter office being operated as a branch of the Seattle district office.

The Seattle office is located at 115 Jackson street, the personnel including Fred L. Webster, district manager, and five salesmen, three of whom are specializing on sawmill work; two men handle the steam, electrical, crushing and cement machinery. The Portland office at First and Stark

streets includes two salesmen, one engaged in sawmill work, and the other handling the balance of the line.

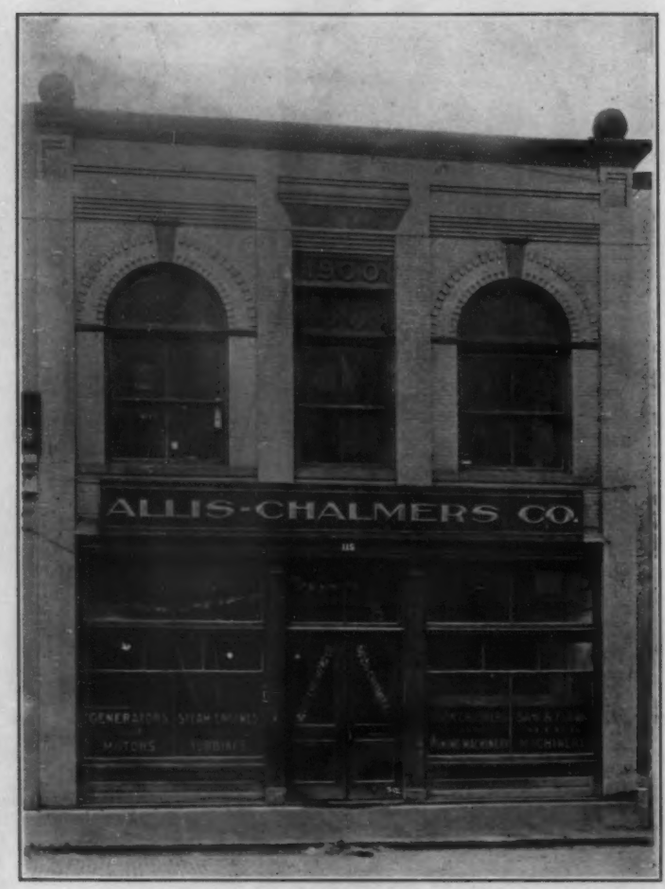
A very complete stock of sawmill machinery repairs, as well as a large consignment of chain for use in sawmills, is carried in the Seattle warehouse and a general stock of




Allis-Chalmers Company, Salt Lake City House.

motors and small generators is carried at both Seattle and Portland.

The Salt Lake City district office is located on the ground floor of the Dooly Building, and is under the management of Frank E. Marcy. This organization includes four sales engineers, whose time is principally devoted to mining machinery,




Allis-Chalmers Company, Seattle House.

cement machinery, and electrical and hydraulic apparatus transactions.

A branch of the Salt Lake City district office located in the Peyton Block, Spokane, is in charge of J. B. Mossman.

## NEW CATALOGUES.

The General Electric Company has just issued their revised catalogue of supplies which is No. 4645, of March, 1909, superseding catalogue No. 7603. It is uniform with the previous edition, substantially bound in blue cloth and lettered in gold; it is systematically arranged, very complete and from a typographical standpoint fully up to the standard established by them on publications of this kind.

MacGovern, Archer & Co., 114-118 Liberty street, New York, are sending out a little booklet to the trade giving a list of electrical and steam machinery, cars and equipment, second-hand, but in first-class condition in every respect and ready for immediate shipment. Dated July and superseding all other lists issued, the book is replete with bargains, from large interurban or single-truck closed cars to air compressors, including motors and dynamos of all kinds.

The A. T. Ames Company of Niles, California, manufacturers of Ames pumps, are distributing catalogue No. 24, recently issued. It includes some data relative to the construction of their pumps and well advanced arguments on the advantages of their product. They have also included an illustrated list of some notable installations with testimonials, tables on heat and pressure of water, friction of water and capacity of cylinders and tanks, which should be of great value to any one engaged in this line of business.

The Electric Storage Battery Company are distributing a booklet just issued giving a sketch of the development of the "Exide" and "Hycap-Exide" batteries which is fully illustrated and should prove very valuable to those interested in storage battery work, particularly as applied to the electric vehicle. It includes a brief description of the history and development of the storage battery plate, with special reference to the application of batteries of electrically propelled vehicles. A description of the "Exide" plate and the "Hycap-Exide" plate is given with an outline of the different processes of manufacture of this type. The booklet also covers the method of asesmbling, showing the care taken in preparing these batteries for the market.

The Westinghouse Electric and Manufacturing Company, Pittsburg, Pa., has issued a handsomely printed little booklet describing the applications of its line of small motors to office, store and shop services. The numerous illustrations scattered through the pages suggest many time and labor saving uses for these efficient little power devices; among these are the motor-driven adding machine, mailing machine, eraser, graphophone, envelope sealer, vacuum cleaner, buffing and polishing wheel, blower, sign-flasher, box-covering machine, hand drill, hack saw, coffee grinder, etc., applications selected at random from the large number of uses where the electric motor provides the ideal power. The booklet, "Westinghouse Electric Motors for the Office, Store and Shop," will be sent on request.

In Bulletin No. 4666, just issued by the General Electric Company, is described an improved form of the well-known Type H transformer, of which there are more than 50,000 in use at the present time. The advantages insured by the new design are: better efficiencies, greater uniformity of impedances, an improved connection board, together with an improved method of supporting the primary and secondary leads, and a new type of suspension hook, as well as a new device for clamping the transformers in the cases.

The bulletin contains numerous illustrations of the transformer, and shows the methods used in the different processes of manufacture. Tables showing the frequency limits, and a curve indicating the reduction in the core and total losses of the improved Type H transformer over previous designs are also shown.

# NEWS NOTES

## FINANCIAL.

MONROVIA, CAL.—The City Council has passed an ordinance providing for issuing bonds of the city in the sum of $16,000 for the purpose of installing a water system.

PALMS, CAL.—The Chamber of Commerce has taken the initial steps toward securing an election to bond the district for the purpose of establishing an electric lighting plant.

GLENDALE, CAL.—An ordinance providing for issuing bonds in the sum of $60,000 for the acquisition of electric lighting works, was taken up at the last Council meeting and passed first and second reading.

MONROVIA, CAL.—Nearly 200 signatures have been secured to a petition now being circulated asking that the City Council hold a bond election calling for bonds in the sum of $50,000 for the purpose of installing a municipal gas plant.

SAN FRANCISCO, CAL.—Suit has been filed in the U. S. Circuit Court by the Metropolitan Light & Power Company against the City and County of San Francisco, its Board of Supervisors and its Mayor, asking that all be enjoined from enforcing the 85-cent gas rate ordinance.

SPOKANE, WASH.—The Washington Water Power Company of Spokane has filed a mortgage of $15,000,000 to cover the amount necessary for the construction of an additional power plant at Little Falls, Wash., and extensions to the present system of power lines, as well as to cover present indebtedness. With exception of the Chicago, Milwaukee & St. Paul, this is the largest mortgage ever filed in the country. The mortgage was to the Farmers' Loan & Trust Company of New York.

OAKLAND, CAL.—Payment of $26,988.04 delinquent taxes, due since the fiscal year 1903-4, has been made into the county treasury by the People's Water Company, successors of the Contra Costa Water Company, which resisted the tax. This brings the total of payments of these delinquent taxes up to $48,000 in round figures. The total the company has agreed to pay, under a compromise of a certain portion of the litigation between it and the county, is $85,000. The county claims to total of $104,943.79.

## INCORPORATIONS.

ONTARIO, ORE.—A new independent telephone company has been incorporated by citizens of Ontario with a capital of $10,000.

PENDLETON, ORE.—The Holdman Telephone Company has been organized with a capital stock of $3000. The object of the company is to build and operate a telephone line to Holdman. J. A. Cresswell is one of the trustees of the new company.

DAYTON, WASH.—The Starbuck Electric Company has been incorporated here with a capital stock of $25,000 by E. A. Bryan, Hattie Bryan and A. W. Bryan. The company has bought the plant of the Starbuck Electric Light & Power Company and will develop power for irrigation and other purposes.

PENDLETON, ORE.—Articles of incorporation were filed by the Umatilla County & Electric Power Company, with a capital stock of $100,000, by State Senator C. J. Smith of Pendleton, et al. The purpose of the company is to develop power from Camas creek, and will build about 200 miles of electric railway in Eastern Oregon, and also irrigate considerable land with waste water.

VANCOUVER, WASH.—Articles of incorporation have been filed by the Clarke County Railway Company, with $150,000 capital, and with the following directors: James G. Kidwell of Walla Walla, J. H. Murphy, A. Welch, C. E. Moulon and Omar C. Spencer. The object of the company is to build electric lines in Clarke County, presumably connecting other towns with Vancouver.

## ILLUMINATION.

HAMILTON, MONT.—W. O. Fisk announces that the electric light plant is to be remodeled and made more modern in every respect.

SAN JOSE, CAL.—A franchise has been sold to the Los Gatos Ice, Gas & Electric Company, for a line of poles and wire for the transmission of electricity.

ESCONDIDO, CAL.—Seth Hartley of Colton has applied to the Trustees for permission to install an electric light and power plant to cost between $26,000 and $30,000.

JACKSONVILLE, ORE.—The County of Jackson has granted a franchise to the Jackson County Electric Light & Power Company to erect pole lines for transmitting power.

NAMPA, IDA.—S. D. Gates of Portland, representing the Portland General Electric Company, has closed a contract with the Dewey Electric Light & Power Company, for an entire new system of electric lights.

LOS ANGELES, CAL.—The Board of Public Works will receive sealed bids up to July 30th for furnishing to the city three 100 horsepower induction motors in accordance with specifications on file at the office of said Board.

UPLANDS, CAL.—The City Council has passed an ordinance granting a franchise to lay gas pipes in streets and thoroughfares of the city for the purpose of carrying and distributing gas for light, heat and power unto J. R. Anderson.

SANTA ANA, CAL.—The City Council has passed an ordinance granting to the Edison Electric Company the right to erect and operate along certain streets, poles, wires and appliances for transmitting electric energy for light, heat and power for a term of 25 years.

SAN ANSELMO, CAL.—There is a movement on foot to have the San Rafael Gas & Electric Company extend its gas mains to San Anselmo. The Trustees have sent out several lists for the people to sign, agreeing to pay $1.50 per 1000 feet to the company. The company will run the mains to San Anselmo if it procures 100 signatures.

OAKLAND, CAL.—Suits for a total of $5,656.92 alleged damages have been filed against the Oakland Gas, Light and Heat Company by the Hartford Fire Insurance Company and the Atlas Assurance Company. The companies had policies covering flats at East Fourteenth street and Second avenue occupied by Flora V. Larsen and Charles C. Strandberg. The flats were partially destroyed by fire, which the plaintiffs say was caused by gas escaping from a bad connection in the piping. The Hartford Company settled for $1,161.73 and the Atlas Company for $3,485.19 on their respective policies as set forth in their complaint. They demand payment of these amounts.

## TRANSMISSION.

SEATTLE, WASH.—The Council has passed a bill appropriating $100,000 for a new power dam at Cedar river.

RHYOLITE, NEV.—The Mayflower Consolidated Mining Company has signed a contract with Nevada-California Power Company for the installation and use of electricity to displace gasoline machinery now in service at both mine and mill.

WHITMORE, CAL.—Another suit has been filed by James Hunt and others of the Cow Creek section against the Sacramento Valley Power Company. This time the plaintiffs ask that the dam of the power company in Cow Creek be removed.

GEORGETOWN, CAL.—William Ross has filed notice of location and appropriation of 2,500 inches of the water of the Cosumnes River at Section 35, Township 9 North, Range 15. The water is to be taken out by means of a restraining dam, reservoir, canals and flumes, and is for the generation of electric power, and other purposes.

SAN BERNARDINO, CAL.—Surveys for the preliminary work on the Victor dam site at the Narrows of the Mojave river are to begin next week by the Mojave River Development Company, a recently organized company of San Francisco and Eastern capitalists, who are preparing to carry on the long-projected work of impounding the waters of the Mojave river for irrigation and power purposes.

SEATTLE, WASH.—Michael Carlos, president of the Hanford Irrigation & Power Company, has purchased 11,000 acres of land from the Northern Pacific Railway Company for $125,000, in Benton county, eastern Washington. The present electric power plant of the company will be enlarged, new generating machines installed and a big body of fertile land on the west bank of the Columbia will be reclaimed.

SEATTLE, WASH.—Bids for the new power plant at the Puget Sound navy yard opened July 10th were as follows: D'Olier Engine Co., Philadelphia, $57,950; Engineering Corporation, $80,700; Hallidie Machinery Co., Seattle, $100,418; Pacific Engineering Company, Seattle, $74,555; Walworth Manufacturing Company, Boston, $78,890; Charles C. Moore & Co., San Francisco, $80,825; Evans, Almiral & Co., New York, $68,798; W. W. Kellogg Co., New York, $66,500.

BAKERSFIELD, CAL.—The Board of Supervisors has been requested by the West Side Electric Company to advertise for sale a franchise for stringing wires for the transmission of electricity to cover the West Side oil fields from Sunset to McKittrick. According to the terms of the advertisement bids will be received up to August 7th and the successful bidder must begin work within four months after the franchise is granted. A bond of $1000 to insure the fulfillment of the conditions of the franchise will be required. The term of the franchise is 50 years and the successful bidder must pay to the county 2 per cent of the gross receipts after the first five years.

NEVADA CITY, CAL.—Headed by A. D. Foote, president of the Middle Yuba Hydro-Electric Company, a crew of workmen and surveyors has gone to the camp on the river, where Mr. Foote will spend the next two months devoting his personal attention to the preliminary work connected with this enterprise. The preliminary work will include surveys for lakes and reservoirs, the erection of a granite dam and construction of ditches and flumes to the site selected for the power house. Surveys for pole power lines will also be made. The company will furnish power and light to Northern Nevada mines and towns and the most prominent Sierra county towns, including Alleghany.

## TRANSPORTATION.

BAKER CITY, ORE.—A franchise has been granted to Anthony Mohr and his associates for a street car line in this city.

KENNEWICK, WASH.—The Kennewick Improvement Company has asked the city for a franchise to build and operate a street car line.

SANTA ROSA, CAL.—The City Council has granted a franchise to the Sonoma & Lake County Railroad as applied for at a previous meeting.

YUMA, ARIZ.—Karr, Kester & Speece have applied to the City Council for a 25-year franchise over the streets of Yuma for an electric railway to be operated in connection with their proposed Colorado River Railroad.

LOS ANGELES, CAL.—The Board of Public Works is receiving sealed bids for furnishing the city with tunnel car wheels, axles, and wheel caps, in accordance with specifications thereof, No. 84, on file with said Board.

MISSOULA, MONT.—The County Commissioners recently granted a 50-year franchise to the Missoula Street Railway Company which permits the company to use the public highways of the city within a radius of four miles of the south end of the Higgins avenue bridge.

LOS ANGELES, CAL.—The City Council has passed an ordinance amending ordinance 14,831 entitled "An ordinance granting to Pacific Electric Railway Company, a corporation, the right to construct and for a period of 21 years to maintain an overhead crossing or trestle across Los Angeles street, in this city.

YUBA CITY, CAL.—Surveyors are at work running lines for the street railway to be constructed in Yuba City by the Northern Electric Company. The track will be laid from the Feather river bridge at Second and Bridge streets, along Second and B, out B to Plumas, up Plumas to Main and thence to Bridge street, where it will connect with the main line. This will form a loop which will give all parts of Yuba City street car service to Marysville.

ELMHURST, CAL.—The Oakland Traction Company is preparing to remodel its car barns and yards at the headquarters of the Hayward division, located at this place. The improvements are to be extensive. A double track is to be laid in place of the single track through the business center here and all the buildings owned by the company, except the power house and foundry, torn down and rebuilt. A large amount of additional trackage is to be laid in the car yards.

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## TELEPHONE.

BERKELEY, CAL.—A contract has been let for the installation of a twenty telephone exchange in the new city hall building.

SHERIDAN, WYO.—The City Council has granted a franchise for an automatic telephone system to R. T. Durrett. Work will be started at once.

WALLA WALLA, WASH.—The American District Telegraph Company will install a private fire alarm system in the city.

WALLACE, IDAHO.—The Bell Telephone company is at work on the line to Coeur d'Alene City straightening the line. The repairs and changes will cost about $15,000.

EUREKA, CAL.—The Pacific Telephone & Telegraph Company has asked for permission to erect poles in certain streets and alleys in the third and fourth wards.